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## Product Safety Assessment

### Sulfuryl Fluoride

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#### Names

- CAS No. 2699-79-8
- PROFUME<sup>®</sup> gas fumigant
- VIKANE<sup>®</sup> gas fumigant
- Sulfuryl fluoride
- Sulfur difluoride dioxide
- Sulfuric oxyfluoride

Although much of the information in this document supports the registration and sale of sulfuryl fluoride in the United States of America, a number of other countries around the world, many of which are also member nations of the OECD (Organization for Economic Co-Operation and Development) have registered sulfuryl fluoride products. For further details consult the country-specific [Product Label](#), [Safety Data Sheet](#), or [Contact Us](#).

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#### Product Overview

- Sulfuryl fluoride is the chemical name for the active ingredient in two gas fumigant products registered to Dow AgroSciences LLC, a wholly-owned subsidiary of The Dow Chemical Company: VIKANE<sup>®</sup> gas fumigant and PROFUME<sup>®</sup> gas fumigant. For further details, see [Product Description](#).
- Sulfuryl fluoride is a colorless, odorless gas at room temperature, but is marketed as a liquefied gas in pressurized cylinders.
- Sulfuryl fluoride fumigants are primarily used to control infestations of insects, other arthropods, and rodents in building materials, household items, and raw and processed agricultural commodities, and in residential structures, nonresidential structures, such as offices, museums and other public buildings, and industrial structures such as mills, processed-food and pet-food handling facilities, warehouses, freight and passenger railcars, vehicles, ships, and shipping containers. They are not used in aircraft and sub-surface ships.<sup>1,2</sup> For further details, see the country-specific [Product Label](#), [Product Uses](#) or [Contact Us](#).
- Those working in manufacturing, packaging, or distribution operations could be exposed to sulfuryl fluoride. Applicators may be exposed to sulfuryl fluoride while fumigating, however, numerous safety practices are required to minimize the potential for exposure. For further details, see the country-specific [Product Label](#), [Product Uses](#) or [Contact Us](#). Applicators and residents may be exposed to residual sulfuryl fluoride upon reentry and/or reoccupation of

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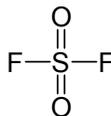
treated structures. Applicators re-entering fumigated buildings prior to aeration to the approved acceptable sulfuryl fluoride exposure concentration are required to wear respiratory protection (positive-pressure self-contained breathing apparatus [SCBA]). Reoccupation is not permitted until aeration procedures are conducted and fumigant concentrations are at or below the acceptable sulfuryl fluoride exposure concentration as verified using an approved detector device of sufficient sensitivity to test the breathing zones.

- Sulfuryl fluoride products are not sold for consumer use and can only be applied by or under the direct supervision of a trained and certified applicator.<sup>3,4,5</sup> For further details, see the country-specific [Product Label](#) or [Exposure Potential](#).
- Contact with sulfuryl fluoride vapor is unlikely to irritate eyes or skin, but contact with subcooled liquid may cause frostbite. Vapor concentrations in fumigated structures are attainable which may cause serious adverse effects, even death, with single exposure due to inhalation. Detailed use requirements are established to minimize the potential for exposure to damaging concentrations of the fumigant. In animal testing, sulfuryl fluoride has been reported to cause effects on the brain, central nervous system, kidneys, lung, respiratory tract, and thyroid gland. Sulfuryl fluoride did not cause cancer or birth defects or interfere with reproduction in laboratory animals, but has been toxic to the fetus in laboratory animals at doses that were toxic to the mother. This product may cause fluorosis of teeth and bones.<sup>6,7</sup> For further details, see [Health Information](#) or the [Safety Data Sheet](#).
- Sulfuryl fluoride is readily biodegradable, does not persist in soil or water environments, and would be removed by biological wastewater-treatment facilities. Sulfuryl fluoride is toxic to mammals, fish, avian, and aquatic organisms. Its bioconcentration potential (tendency to accumulate in the food chain) is low and potential for mobility in soil is very high.<sup>8,9</sup> For further details, see [Environmental Information](#) or [Product Label](#).
- Sulfuryl fluoride is stable under normal storage and use conditions. Although it is not combustible, it can decompose to form hydrogen fluoride and sulfur dioxide if temperatures exceed 400°F. Cylinders exposed to fire may vent and release toxic gas through the fusible plugs on cylinders.<sup>10</sup> Consult the [Product Label](#) for specific use and storage information. For further details, see [Physical Hazard Information](#).

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## Manufacture of Product<sup>11</sup>

Sulfuryl fluoride is produced in Pittsburg, CA using a proprietary manufacturing process. The chemical structure of sulfuryl fluoride is shown below.



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## Product Description<sup>12,13</sup>

Sulfuryl fluoride is the chemical name for the active ingredient in two gas fumigant products registered to Dow AgroSciences LLC: VIKANE<sup>®</sup> fumigant and PROFUME<sup>®</sup> fumigant. Sulfuryl fluoride is a colorless, odorless gas at room temperature, but is marketed as a liquefied gas in pressurized cylinders containing 99.8% sulfuryl fluoride and 0.2% impurities.

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## Product Uses and Regulatory Information<sup>14,15,16,17,18</sup>

Sulfuryl fluoride is used to fumigate building materials, household items, and raw and processed agricultural commodities. It is also used in residential structures, nonresidential structures such as offices, museums and other public buildings, and industrial structures such as mills, processed-food and pet-food handling facilities, warehouses, freight and passenger railcars, vehicles, ships, and shipping containers. It disrupts the glycolysis and citric acid cycles within cells throughout the insect's body, thereby depriving insects of the necessary energy for survival.

- VIKANE<sup>®</sup> fumigant is used in dwellings and other buildings, construction materials, furnishings, and vehicles.
- PROFUME<sup>®</sup> fumigant is used for postharvest fumigation for a variety of food commodities and for food storage and processing structures.

These products control numerous insect pests, including termites, powder post beetles, old house borers, bedbugs, carpet beetles, clothes moths, cockroaches, stored-product arthropod pests, as well as, rats and mice. Only PROFUME is registered for any food- or feed-related uses.

Sulfuryl fluoride products are registered for use in many countries around the world, almost all of which are member nations of the [Organisation for Economic Co-operation and Development \(OECD\)](#). These include Australia, Austria, Belgium, Canada, Finland, France, Germany, Greece, Indonesia, Ireland, Italy, Japan, Mexico, the Netherlands, Norway, Spain, Sweden, Switzerland, Trinidad and Tobago, Turkey, the United Kingdom and the United States. Examples of authorized use registrations for the United States, the European Union (EU), and Australia are noted in the **Additional Information** section. For further details, consult the country-specific [Safety Data Sheet](#), [Product Label](#), or [Contact Us](#).

Regulations also exist that govern the manufacture, sale, transportation, and/or disposal of sulfuryl fluoride. These regulations may vary by city, state, country, or geographic region. For further details, consult the country-specific [Safety Data Sheet](#), [Product Label](#), or [Contact Us](#).

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## Exposure Potential<sup>19,20</sup>

Sulfuryl fluoride is a gas fumigant. The U.S. Environmental Protection Agency (EPA) considers sulfuryl fluoride a Restricted Use product. It may only be applied by or under the supervision of a trained, certified applicator. Extensive worker and bystander safety precautions are included as part of the training process and must be followed during any fumigation. However, based on the uses for this product, the public could potentially be exposed through:

- **Workplace exposure** – Applicators may be exposed to sulfuryl fluoride while applying the fumigant. However, the label requires use of specific Personal Protective Equipment (PPE), fumigation procedures, fumigant detection equipment, and clearance procedures to minimize potential exposure. Exposure could occur in facilities that manufacture, package or handle sulfuryl fluoride. Those working in manufacturing operations could be exposed during maintenance, sampling, testing, or other procedures. Each facility has thorough training programs for employees and appropriate work processes, ventilation, and safety equipment in place to protect against exposure. See [Health Information](#) and [Product Label](#).
- **Consumer exposure to products containing sulfuryl fluoride** – Residents may be exposed to low-level residual sulfuryl fluoride when reentering treated structures. However, reoccupation is not permitted until detection equipment demonstrates that fumigant levels have declined to levels approved by Regulatory agencies. See [Health Information](#).
- **Environmental releases** – The bioconcentration potential of sulfuryl fluoride is low and the potential for mobility in soil is very high. Sulfuryl fluoride is readily biodegradable and is not expected to persist in soil and water. It would be removed by biological wastewater-treatment facilities. Following fumigation and ventilation of treated structures, it is not likely that

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nontarget organisms would be exposed to residual sulfuryl fluoride or that it would leach into groundwater. Please consult the country-specific [Safety Data Sheet](#) or [Product Label](#) for more information about protective equipment and procedures. See [Environmental](#), [Health](#), and [Physical Hazard Information](#).

- **Large release** – Industrial releases are infrequent and generally contained. If a large release does occur, evacuate the area immediately and stay upwind. Personnel engaged in clean-up of spills must wear appropriate protective equipment. Consult the country-specific [Safety Data Sheet](#) or [Product Label](#) for more detailed information about protective equipment and procedures. See [Environmental](#), [Health](#), and [Physical Hazard Information](#).
- **In case of fire** – Sulfuryl fluoride is not combustible. If a fire occurs, keep people away. Use firefighting methods and equipment appropriate to the surrounding materials. Firefighters should wear positive-pressure, self-contained breathing apparatus (SCBA) and protective firefighting clothing. Toxic and irritating gases and fumes can be released. Consult the country-specific [Product Label](#) and [Safety Data Sheet](#) for specific firefighting measures. Follow emergency procedures carefully. See [Environmental](#), [Health](#), and [Physical Hazard Information](#).
- **Emergency Response Information** – In case of an emergency such as poisoning, product spillage, or fire associated with a Dow AgroSciences LLC product in the United States call **800-992-5994** (more information is available at <http://www.dowagro.com/rc/response/na.htm>). For emergencies outside the U.S., access <http://www.dowagro.com/re/response/index.htm> for a list of country sites or contact pages for relevant information.

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## Health Information<sup>21,22</sup>

**Laboratory testing** – Sulfuryl fluoride has been evaluated by comprehensive regulatory schemes used to register products in the US and EU (i.e., U.S. Federal Insecticides, Fungicides, Rodenticides Act and EU Directives for Plant Protection and Biocidal Products). These schemes require laboratory testing for potential short-term (acute) and long-term (chronic) health effects. These tests help scientists determine how chemicals might affect humans, domestic animals, or wildlife in cases of overexposure. Pesticide products used according to label directions are unlikely to cause toxic effects. The amount of pesticide that people and pets may be exposed to is low compared to concentrations used in laboratory testing.

Health information for formulated sulfuryl fluoride products is summarized on country-specific [Safety Data Sheets](#). These are a preferred source for specific health information as product formulations may contain components or additives with additional risks. For further details, also consult country-specific [Product Labels](#).

An overview of health information for sulfuryl fluoride technical product appears below.

**Eye contact** – Gas is essentially nonirritating to eyes. Contact with liquid may cause frostbite or serious damage to eyes.

**Skin contact** – Liquid causes burns and may cause frostbite. No adverse effects are anticipated by skin absorption. Gas is essentially nonirritating to skin.

**Inhalation** – Vapor concentrations are attainable that may be fatal with a single exposure. Excessive exposure may cause severe irritation to the upper respiratory tract (nose and throat) and lungs.

**Ingestion** – This material has moderate toxicity if swallowed. Swallowing is unlikely because of the physical state (gas).

**Cancer and birth defects** – In animal testing, sulfuryl fluoride did not cause cancer or birth defects, or interfere with reproduction. It has been toxic to the fetus in laboratory animals, but only at doses that were toxic to the mother.

**Systemic effects** – In animal testing, sulfuryl fluoride has been reported to cause effects on the brain, central nervous system, kidneys, lung, respiratory tract, and thyroid gland.

For more information, see the country-specific [Product Label](#), [Safety Data Sheet](#) or [Contact Us](#).

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### **Environmental Information reviews and approvals** <sup>23,24,25,26,</sup>

Although sulfuryl fluoride can be very highly toxic to mammals, fish, avian and aquatic organisms, when used appropriately, sulfuryl fluoride is not expected to adversely effect the environment or leach into groundwater. Its bioconcentration potential (tendency to accumulate in the food chain) is low. Sulfuryl fluoride is readily biodegradable, not expected to persist in the aqueous and soil environments, and would be removed by biological wastewater-treatment facilities.

For more information, see the country-specific [Product Label](#), [Safety Data Sheet](#) or [Contact Us](#).

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### **Physical Hazard Information**<sup>27</sup>

Sulfuryl fluoride is stable at recommended storage and use conditions. Although it is not combustible, it can decompose to form hydrogen fluoride and sulfur dioxide if temperatures exceed 400°F. Cylinders may leak or rupture during a fire. Decomposition products may include sulfur dioxide and hydrogen fluoride. Avoid contact with strong bases.

Consult the [Product Label](#) for specific use and storage information. For more information, see the country-specific [Product Label](#), [Safety Data Sheet](#) or [Contact Us](#).

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### **Additional Information**

- Safety Data Sheets and Product Labels ([www.dowagro.com/label/index.htm](http://www.dowagro.com/label/index.htm))
- Contact Us ([www.dowagro.com/contact/index.htm](http://www.dowagro.com/contact/index.htm))
- “Reregistration Eligibility Decision: Sulfuryl Fluoride,” Special Review and Reregistration Division, Office of Prevention, Pesticides and Toxic Substances, U.S. Environmental Protection Agency, LIST A, Case 0176 ([www.epa.gov/oppsrrd1/REDs/old\\_reds/sulfuryl\\_fluoride.pdf](http://www.epa.gov/oppsrrd1/REDs/old_reds/sulfuryl_fluoride.pdf))
- “EPA R.E.D. Facts: Sulfuryl Fluoride,” Office of Prevention, Pesticides and Toxic Substances, U.S. Environmental Protection Agency, EPA 738-F-93-012, September 1993 ([www.epa.gov/oppsrrd1/REDs/factsheets/0176fact.pdf](http://www.epa.gov/oppsrrd1/REDs/factsheets/0176fact.pdf))
- “Acute Exposure Guideline Levels (AEGs) for Sulfuryl Fluoride 2699-79-8, Interim Report,” U.S. Environmental Protection Agency, June 2008 ([www.epa.gov/oppt/aegl/pubs/sulfurylfluoride\\_interim\\_ornl\\_jun\\_2008c.pdf](http://www.epa.gov/oppt/aegl/pubs/sulfurylfluoride_interim_ornl_jun_2008c.pdf))
- *Frequently Asked Questions on ProFume® Gas Fumigant*, Dow AgroSciences United Kingdom web site ([www.dowagro.com/profume/uk/faq/](http://www.dowagro.com/profume/uk/faq/))
- Food Uses (ProFume) EU approval titled: *COMMISSION DIRECTIVE 2010/38/EU of 18 June 2010 amending Council Directive 91/414/EEC to include sulfuryl fluoride as active substance* ([eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:154:0021:0023:EN:PDF](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:154:0021:0023:EN:PDF))

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- Non-Food Uses (VIKANE<sup>®</sup>) EU approval titled: *COMMISSION DIRECTIVE 2009/84/EC of 28 July 2009 amending Directive 98/8/EC of the European Parliament and of the Council to include sulfuryl fluoride as an active substance in Annex I*  
([eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:197:0067:0069:EN:PDF](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:197:0067:0069:EN:PDF))
- ProFume<sup>®</sup> Australian Pesticides and Veterinary Medicines Authority Review  
([www.apvma.gov.au/publications/gazette/2007/09/gazette\\_2007-09-05\\_page\\_18.pdf](http://www.apvma.gov.au/publications/gazette/2007/09/gazette_2007-09-05_page_18.pdf))

For more business information about sulfuryl fluoride products, visit the Dow AgroSciences LLC web site at [www.dowagro.com/homepage/index.htm](http://www.dowagro.com/homepage/index.htm).

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## References

- <sup>1</sup> *PROFUME<sup>®</sup> Gas Fumigant Specimen Label*, Dow AgroSciences LLC, July 2005, page 1.
- <sup>2</sup> *VIKANE<sup>®</sup> Gas Fumigant Specimen Label*, Dow AgroSciences LLC, December 4, 2009, page 1.
- <sup>3</sup> "EPA R.E.D. Facts: Sulfuryl Fluoride," Special Review and Reregistration Division, Office of Prevention, Pesticides and Toxic Substances, U.S. Environmental Protection Agency, EPA 738-F-93-012, September 1993, page 3.
- <sup>4</sup> *PROFUME Gas Fumigant Specimen Label*, Dow AgroSciences LLC, July 2005, page 1.
- <sup>5</sup> *VIKANE Gas Fumigant Specimen Label*, Dow AgroSciences LLC, December 4, 2009, page 1.
- <sup>6</sup> *PROFUME Gas Fumigant Material Safety Data Sheet*, Dow AgroSciences Canada Inc., May 1, 2008, pages 1 and 3–4.
- <sup>7</sup> *VIKANE Gas Fumigant Material Safety Data Sheet*, Dow AgroSciences LLC, January 27, 2010, pages 1 and 3.
- <sup>8</sup> *PROFUME Gas Fumigant Material Safety Data Sheet*, Dow AgroSciences Canada Inc., May 1, 2008, page 4.
- <sup>9</sup> *VIKANE Gas Fumigant Material Safety Data Sheet*, Dow AgroSciences LLC, January 27, 2010, pages 1 and 3.
- <sup>10</sup> *VIKANE Gas Fumigant Material Safety Data Sheet*, Dow AgroSciences LLC, January 27, 2010, pages 2 and 3.
- <sup>11</sup> "Acute Exposure Guideline Levels (AEGLs) for Sulfuryl Fluoride 2699-79-8, Interim Report," U.S. Environmental Protection Agency, June 2008, page 7.
- <sup>12</sup> "Reregistration Eligibility Decision: Sulfuryl Fluoride," Special Review and Reregistration Division, Office of Prevention, Pesticides and Toxic Substances, U.S. Environmental Protection Agency, LIST A, Case 0176, pages 3–4. September 1993
- <sup>13</sup> "Acute Exposure Guideline Levels (AEGLs) for Sulfuryl Fluoride 2699-79-8, Interim Report," U.S. Environmental Protection Agency, June 2008, page 8.
- <sup>14</sup> "EPA R.E.D. Facts: Sulfuryl Fluoride," Special Review and Reregistration Division, Office of Prevention, Pesticides and Toxic Substances, U.S. Environmental Protection Agency, EPA 738-F-93-012, September 1993, page 1.
- <sup>15</sup> "Acute Exposure Guideline Levels (AEGLs) for Sulfuryl Fluoride 2699-79-8, Interim Report," U.S. Environmental Protection Agency, June 2008, page 8.
- <sup>16</sup> *PROFUME Gas Fumigant Specimen Label*, Dow AgroSciences LLC, July 2005, page 1.
- <sup>17</sup> *VIKANE Gas Fumigant Specimen Label*, Dow AgroSciences LLC, December 4, 2009, page 1.
- <sup>18</sup> *Frequently Asked Questions on ProFume Gas Fumigant*, Dow AgroSciences United Kingdom, web site accessed on July 6, 2010.
- <sup>19</sup> "EPA R.E.D. Facts: Sulfuryl Fluoride," Special Review and Reregistration Division, Office of Prevention, Pesticides and Toxic Substances, U.S. Environmental Protection Agency, EPA 738-F-93-012, September 1993, pages 2–3.
- <sup>20</sup> *PROFUME Gas Fumigant Material Safety Data Sheet*, Dow AgroSciences Canada Inc., May 1, 2008, page 2.
- <sup>21</sup> *PROFUME Gas Fumigant Material Safety Data Sheet*, Dow AgroSciences Canada Inc., May 1, 2008, pages 3–4.

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- <sup>22</sup> VIKANE® Gas Fumigant Material Safety Data Sheet, Dow AgroSciences LLC, January 27, 2010, pages 1 and 3.
- <sup>23</sup> "EPA R.E.D. Facts: Sulfuryl Fluoride," Special Review and Reregistration Division, Office of Prevention, Pesticides and Toxic Substances, U.S. Environmental Protection Agency, EPA 738-F-93-012, September 1993, page 4.
- <sup>24</sup> VIKANE Gas Fumigant Material Safety Data Sheet, Dow AgroSciences LLC, January 27, 2010, pages 1 and 3.
- <sup>25</sup> Food Uses (ProFume) EU approval titled: *COMMISSION DIRECTIVE 2010/38/EU of 18 June 2010 amending Council Directive 91/414/EEC to include sulfuryl fluoride as active substance*: [eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:154:0021:0023:EN:PDF](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:154:0021:0023:EN:PDF)
- <sup>26</sup> Non-Food Uses (Vikane) EU approval titled: *COMMISSION DIRECTIVE 2009/84/EC of 28 July 2009 amending Directive 98/8/EC of the European Parliament and of the Council to include sulfuryl fluoride as an active substance in Annex I*: [eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:197:0067:0069:EN:PDF](http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:197:0067:0069:EN:PDF)
- <sup>27</sup> VIKANE Gas Fumigant Material Safety Data Sheet, Dow AgroSciences LLC, January 27, 2010, pages 2 and 3.

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NOTICES:

As part of its 2015 Sustainability Goals, Dow has committed to make publicly available safety assessments for its products globally. This product safety assessment is intended to give general information about the chemical (or categories of chemicals) addressed. It is not intended to provide an in-depth discussion of health and safety information. Additional information is available through the relevant Material Safety Data Sheet, which should be consulted before use of the chemical. This product safety assessment does not replace required communication documents such as the Material Safety Data Sheet.

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